REMARKS

In the Office Action mailed 5 November 2003, the Examiner objected to the specification and a typographical error in claim 85; substantively rejected claims 60-64, 68, 70-80, and 82-86; and objected to claims 65 and 81, indicating that they define patentably over the art. (The first page of the Office Action says that all of the pending claims are rejected, but on page 9 the Examiner merely objects to claims 65 and 81 and states that they would be allowable if rewritten in independent form . Claims 66, 67, and 69 depend from claim 65 and the Examiner states no basis for rejecting or objecting to any of claims 65-67, 69, and 81.)

The undersigned respectfully asks the Examiner to reconsider this application in light of this amendment and the following comments. The undersigned hereby petitions for a three-month extension of time, the fee for which may be charged to Deposit Account No. 50-0665. Any other fees due during pendency of this application, including any additional fees necessitated by this amendment, may also be charged to Deposit Account No. 50-0665.

I. Amendments

In objecting to the specification, the Examiner suggested that the title be amended to refer to "method" instead of "apparatus and method." The present amendment rewrites the title as the Examiner requests.

Claims 60-62, 68, 69, 73, 75, 82, 83, 85, and 86 have been amended. The amendments to claims 60-62, 82, 85, and 86 are merely cosmetic in nature and are not intended to narrow the claims in any way. The change in dependency of claims 69 and 75 is believed to broaden, not narrow, the scope of each of these claims.

II. Rejections under 35 U.S.C. § 103

A. The Applied Art

In rejecting claims 60-64, 68, 70-80, and 82-86, the Examiner relies on various combinations of at least two of the following five US Patents – Re 35,513 ("Nobel"), 4,134,802 ("Herr"), 5,252,196 ("Sonnenberg"), 5,972,192 ("Dubin"), and 6,565,731 ("Couble"). Although all of these patents generally relate to the broad field of

electrochemical treatment, each of them addresses a distinct concern in a different manner.

Sonnenberg is the primary reference in each of the articulated rejections. Sonnenberg discloses a process and bath composition for electrocatalytic plating. The process aspect of Sonnenberg's contribution to the art appears to lie in the ability to analyze the concentration of certain brightening and leveling agents down to ppb concentrations. Throughout the disclosure, Sonnenberg stresses that the concentrations – both absolute and relative - of the bath composition constituents, particularly the brightening and leveling agents, are "critical" or "crucial." (See, e.g., line 2 of the Abstract and column 10, lines 23-34 and 45-49.) Sonnenberg mentions a variety of plating operations conducted at current densities of anywhere from 1 to 200 amp/ft^2 (ASF) for times of 0.001 sec. to 27 minutes. However, all of the examples employ a current density of at least 10 ASF. The brightener forms a brightener active species and a dimer of that species (column 8, lines 54-59) and an equilibrium concentration of these components in the bath appears to be important in practical operation (column 9, lines 34-45). Current density is listed first among the factors that can alter this equilibrium (column 8, line 63 – column 9, line 2).

The Examiner cites Nobel as teaching plating times of 1-5 minutes. Nobel's examples describe processes for electroplating copper wire, brass and steel panels or coupons. In these examples, plating times range from 36 minutes at "5 and 10" ASF to 1.5 minutes at 50 ASF. There is no suggestion that such a process would be suitable for workpieces on which microelectronic devices are to be formed. One of the resultant bulk coatings is described as bright, but the rest are characterized as semi-bright or matte in appearance. The Examiner relies on Herr as mentioning boric acid as a component of a plating bath and on Dubin as teaching plating with periodic pulses.

Couble discloses solutions that can be used to prepare a printed circuit board (PCB) for subsequent electroplating. More particularly, an initial solution is intended to perform two specific functions– 1) neutralize permanganate residue in through-holes left from a desmearing step, and 2) modify the surface charge of the hole wall. Thereafter, a carbonaceous coating may be deposited by treating the PCB with a graphite- or carbon black-based aqueous solution. As shown in Example 2, for example, this latter

aqueous solution is washed off and the PCB may be electroplated using an off-the-shelf acid electroplating bath (column 12, lines 49-61).

B. Claims 60-64, 68, and 70-80

Claim 60 defines a process for applying a metal structure to a workpiece on which one or more microelectronic devices are to be formed. a surface of the workpiece is exposed to a bath that includes a source of metal ions, boric acid, and a complexing agent. electroplating power is applied between the workpiece and an electrode in electrical contact with the bath to electroplate metal on the workpiece. Claim 60 also specifies that electroplating power is applied during at least a portion of the first deposition process for a workpiece surface current density of between 1 mA/cm^2 and 5 mA/cm^2.

The Examiner rejects claim 60 as obvious over Sonnenberg in view of Herr, with Herr being cited solely as suggesting the use of boric acid. To support even a *prima facie* obviousness rejection under 35 USC § 103(a), either the applied references must teach every feature of the claimed invention or the Examiner has to cogently explain why one of ordinary skill in the art clearly would have been motivated to modify the teachings to arrive at the claimed invention. In this case, the Examiner has done neither.

The undersigned disagrees with several aspects of the Examiner's reading of Sonnenberg and the application of that reading to the claims at hand. One of the more fundamental differences, however, lies in the Examiner's characterization of Sonnenberg as teaching the use of a current density of between 1 and 5 mA/cm^2. In support of this proposition, the Examiner notes that Sonnenberg suggests a range of current densities that happens to encompass the specified range. At no point does the Examiner allege that Sonnenberg mentions a current density even near 5 mA/cm^2, though. Absent that explicit teaching, the Examiner has to articulate a motivation for those in the art to modify Sonnenberg's teachings to arrive at the claimed invention. As the Examiner has not given such a motivation, the undersigned respectfully submits that the Office Action fails to state a proper rejection of claim 60.

Sonnenberg suggests surface current densities of 1-200 ASF, but notes that a more specific range of 1-40 ASF (which the Examiner suggests equates to 0.93-37

mA/cm^2) may be useful in electroplating. Claim 60, in contrast, specifies surface current densities of 1-5 mA/cm^2. Even the narrowest range mentioned by Sonnenberg, 0.93-37 mA/cm^2, is nearly an order of magnitude wider than the 4 mA/cm^2-wide range encompassed by claim 60. Furthermore, surface current densities of 1-5 mA/cm^2 have proven particularly effective in certain applications. As one particular example discussed in the present application, a low surface current density of 1-5 mA/cm^2 can be used to enhance an ultra-thin seed layer to form a thin, highly conformal layer more suitable for faster plating. At higher current densities, the deposited copper layer tends to conform less effectively, which can yield a final electrodeposited layer with higher resistivity and poor uniformity.

As pointed out in the summary above, Sonnenberg may suggest a broad range, but each and every example employs a current density of at least 10 ASF (9.3 mA/cm^2). Higher current densities generally yield higher throughput and lower cost. Given the impact of current density on the "critical" equilibrium concentrations of the brightener, one of ordinary skill in the art would have every disincentive, and no incentive, to select the specific range of current densities required in claim 60.

Hence, Claim 60 is patentable over Sonnenberg taken either alone or in view of Herr. Claims 61-64, 68, and 70-80 all depend from claim 60 and are believed allowable at least on that basis.

The undersigned also takes issue with the Examiner's combination of Sonnenberg and Herr with Couble in rejecting claim 70. As noted in the summary of Couble, this reference discloses two solutions – a permanganate neutralizing solution and a carbonaceous coating solution – that can be used to prepare a PCB for subsequent electroplating. Claim 70 calls for an alkaline electroplating bath, which the Examiner admits is not suggested by Sonnenberg. The Examiner tries to cure this deficiency by pointing to the pH of Couble's carbonaceous coating solution and arguing this would lead a skilled practitioner to change Sonnenberg's acidic electroplating solution into an alkaline solution. The undersigned can see no reason that one skilled in the art would believe that such a combination would improve Sonnenberg's carefully composed acidic solution. The discordant nature of the suggested combination is highlighted in Example 2 of Couble, which specifically teaches use of a commercial acid

electroplating bath for electroplating a PCB that bears the carbonaceous coating (column 12, lines 56-61).

C. Claim 82

Claim 82 calls for, *inter alia*, use of a current plating density of 1-5 mA/cm^2. The Examiner does not claim Couble suggests such a By analogy to the preceding discussion of claim 60, claim 82 is patentable over the stated combination of references. Furthermore, the undersigned fails to see any bearing or relationship between Couble's permanganate neutralizing and carbonaceous coating solutions have to do with the claimed invention, particularly when Couble explicitly suggests the use of a commercial plating bath.

D. Claims 83-86

Aspects of claims 83-86 parallel aspects of claims 60 and 82 discussed above. By analogy, therefore, the undersigned respectfully submits that these claims are patentable, as well.

III. Conclusion

In view of the foregoing, the claims pending in the application comply with the requirements of 35 U.S.C. § 112 and patentably define over the applied art. A Notice of Allowance is, therefore, respectfully requested. If the Examiner has any questions or believes a telephone conference would expedite prosecution of this application, the Examiner is encouraged to call the undersigned at (206) 359-8000.

Respectfully submitted,
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